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SURFACE PLATE STRUCTURE IN LAMINATING DEVICE FOR GLASS SUBSTRATE FOR LIQUID CRYSTAL DISPLAY PLATE

[Abstract]

PURPOSE: To provide a surface plate of a laminating device with which marks of upper and lower glass substrates are aligned and a sealing material between glass substrates can be uniformly pressed to make a const. gap between the upper and lower glass substrates even when the upper and lower glass substrates are inclined or tapered.

CONSTITUTION: A recessed part 21 is formed on the surface of a surface plate 19 facing a glass substrate while the peripheral edge 20 is left. The

lower opening of the recessed part 21 is closed with a thin plate 22 and the edge of the thin plate 22 is adhered and fixed to the peripheral edge 20. Sucking holes are formed in proper positions of the thin plate 22 and each sucking hole is connected to an evacuating means installed in the surface plate main body 19. Further, an air supply means to the recessed part 21 is installed to the surface plate main body 19. The corner of the main body 19 is provided with a seeing-through part 30 to see the positioning mark in the glass substrate.

[Claims]

[Claim 1] A surface plate structure in an attachment device for glass substrates constituting a liquid crystal display panel comprising a fixed plate provided with a lower surface plate and a movable plate moving up and down and provided with an upper surface plate, wherein a recessed part is formed on a surface facing a glass substrate, of a metal surface plate main body of one of the upper and lower surface plates while a peripheral edge is left, a lower opening of the recessed part is closed with a thin plate, an edge of the thin plate is adhered and fixed to the peripheral edge, suction holes are formed in proper positions of the thin plate, each suction hole is connected to an evacuating means installed at the surface plate main body, and an air supply means for supplying air to the recessed part is installed at the surface plate main body.

[Claim 2] The device of claim 1, wherein a transparent part for performing mark alignment of the glass substrates is installed at each corner of the surface plate main body having a rectangular shape.

[Title of the Invention]

SURFACE PLATE STRUCTURE IN LAMINATING DEVICE FOR GLASS SUBSTRATE FOR LIQUID CRYSTAL DISPLAY PLATE

[Detailed Description of the Invention]

[Field of the Invention]

The present invention relates to amelioration of upper and lower surface plates installed at an attachment (bonding, lamination) device of glass substrates (upper and lower electrode plates) constituting a liquid crystal display panel.

[Description of the Prior Art]

In a liquid crystal display (LCD) panel, two glass substrates coated with a transparent conductive electrode maintain a predetermined interval therebetween by using spacers of several micrometers, and a liquid crystal is sealed within a space of the divided inside by a sealing material, such that the two glass substrate are aligned by position aligning marks and attached (laminated, bonded).

When two glass substrates are attached by an attachment device in accordance with the prior art, position alignment marks prepared to the glass substrates are roughly aligned and precisely aligned such that an upper surface plate moving in the direction of X and a lower surface plate moving in the directions of Y and θ are driven, moved and adjusted by data detected by a mark detecting means including a microscope and a camera. When the mark alignment is completed, the two glass substrates are pressed thereby, pressing a sealing material and accordingly maintain a gap therebetween.

The upper and lower surface plates of the prior art attachment device may have flat surfaces as a metal material is processed thereon, but they may not be parallel to each other because of presence of an inclination of a micron unit. Also, a thickness of the attached upper and lower glass substrates is tapered by a micro unit. For this reason, although a constant (uniform) gap within a range of 5~6μ is intended between the glass substrates constituting a liquid crystal display panel by being attached together, the gap between the upper and lower glass substrate cannot be uniform because a sealing material c is pressed unevenly when the upper and lower substrates a and b are pressed. Once the gap between the glass substrates is not uniform, one completed LCD panel makes a defective operation such as color unevenness.

In order to solve the aforementioned problems, a technology of applying an airbag-like shape, instead of a metal surface plate, to both the upper and lower surface plates or to only a movable surface plate so as to secure a constant gap between the substrates although the glass substrate is tapered, has been developed.

[Problems to be solved by the Invention]

However, the airbag-like shape cannot suction a glass substrate to be attached toward a surface plate and maintain the suctioned state. Therefore, the mark alignment operation performed before the attachment of the upper and lower glass substrates cannot be performed in the attachment device provided with the airbag surface plate. For this reason, the mark alignment of the upper and lower glass substrates is performed in a different device, the two glass substrates having completed the mark alignment are

temporarily fixed by using a resin adhesive so as not to be misaligned, and then in such a state, the attachment is performed by the attachment device. Namely, the mark alignment process and the attachment process should be performed in different devices, which causes inconvenience, and the operation of the temporarily fixation is undesirably required between the mark alignment process and the following attachment process.

To solve the problems of the prior art, the present invention provides a surface plate of an attachment device capable of aligning marks of upper and lower glass substrates and making a constant gap between upper and lower glass substrates by evenly pressing a sealing material between the glass substrates although the upper and lower glass substrates are inclined or tapered.

[Means for Solving the Problem]

As for a technical means proposed by the present invention in order to attain the aforementioned object, an attachment device for glass substrates constituting a liquid crystal display panel includes a fixed plate provided with a lower surface plate and a movable plate provided with an upper surface plate and moving up and down. A recessed part is formed on a surface facing a glass substrate, of a metal surface plate main body of one of the upper and lower surface plates while the peripheral edge is left. A lower opening of the recessed part is closed with a thin plate and an edge of the thin plate is adhered and fixed to the peripheral edge. Also, suction holes are formed in proper positions of the thin plate and each suction hole is connected to an evacuating means installed in the surface plate main body. Further, an air supply means supplying air to the recessed part is

installed at the surface plate main body.

As the thin plate closing the recessed part of the metal surface plate main body, a metal thin plate (e.g., stainless thin plate) whose thickness is about 30μ to 200μ, preferably, a stainless thin plate of 100μ may be used, and a synthetic resin thin plate having a high extension elasticity rate (e.g., thin plate made of polycarbonate) or the like may be used. Also, the suction hole formed at the thin plate has a vacuum suction force as the thin plate is perforated, a pipe joint flange of a metal material is put into and fixed to a perforation (hole), a miniature tube joint is connected to the pipe joint flange, and the miniature tube joint communicates with a connection port of a manifold disposed at the metallic surface plate main body.

The air supply means communicating with the recessed part is connected and installed to a side surface of the peripheral edge of the metal surface plate main body, and the thin plate closing the lower opening of the recessed part is pressurized and expanded outwardly from the inside by the air sent from the air supply means to thereby perform a buffering operation. Also, when the glass substrates are pressed to be attached together, the pressing may be made by mechanically and vertically moving the movable plate having the surface plate, by varying the expansion rate of the thin plate by the air pressure applied to the recessed part, or by combining both. A transparent part is provided at each part of the metal surface plate main body to use for the mark alignment of the glass substrates.

[Function]

In the attachment device, a recessed part is formed on a surface of one of the upper and lower surface plates which faces a glass substrate

while a peripheral edge is left. A lower opening of the recessed part is closed with a thin plate and an edge of the thin plate is adhered and fixed to the peripheral edge. Also, suction holes are formed in proper positions of the thin plate and each suction hole is connected to an evacuating means installed in the surface plate main body. Therefore, the glass substrate is sucked by a vacuum suction force generated at the suction hole. Accordingly, the position alignment marks of the glass substrates can be aligned.

As the thin plate is expanded outwardly by the air sent by the air supply means into the recessed part of the surface plate, the thin plate gets a shape like the leather of a drum. Thus, the surface plate can work a buffer. Accordingly, the glass substrate is pressed, undergoing the buffer operation so that a degree to which the glass substrates are tapered or inclined is attenuated, and a sealing material is uniformly pressed, making a constant gap between the upper and lower substrates.

[Embodiment of the Invention]

An embodiment in which a surface plate related to the present invention is used as an upper surface plate of a movable plate will now be described with reference to accompanying drawings. An attachment device A includes a machine frame 1, a fixed plate 2 fixed to a lower side within the machine frame 1 and a movable plate 3 disposed above the fixed plate 2. A lower surface plate 4 supporting a lower glass substrate a is installed on the fixed plate 2, and an upper surface plate 5 suction(absorbing) an upper glass substrate b and maintaining the sucked state thereof is installed under the movable plate 3.

The movable plate 3 disposed above the fixed plate 2 is engaged with a guide rail 7, which is fixed to four stanchions 6 constituting the machine frame 1, through an engagement body 8 sliding in upward and downward direction and thus can move up and down. Two suspended rods 9 are disposed and stand as nearly a rectangular shape on a plane on a surface of the movable plate 3, and upper ends of the suspended rods 9 are connected to a connection plate 10, penetrating a horizontal lever 11 passed between the stanchions. A spring 12 is mounted around each of the suspended rods 9, pressed between the horizontal lever 11 and the connection plate 10, and the rods 9 receives a support so that the movable plate 3 is not dropped down by its self-weight to a bottom dead point. Also, as a driving source for forcibly pressing the movable plate 3, an air cylinder 13 is used, and the air cylinder 13 is suspended from and fixed to the horizontal lever and presses the movable plate 3 at a front end of a flexible rod 13'.

The lower surface plate 4 installed on the fixed plate 2 includes a lower member 14 sliding on the fixed plate 2 in the direction of Y and an upper member 15 installed on the lower member 14 and horizontally rotating. The lower member 14 is slidably supported by two parallel guide rails 16 standing on and fixed to the fixed plate 2 through an engagement body 17 engaged to the guide rails. Also, the upper member 15 is rotatably supported by the lower member 14 through a bearing 18.

As for the upper surface plate 5 mounted under the movable plate 3 and moving in the direction of X, a recessed part 21 having a predetermined depth is formed at a surface facing a glass substrate 20, of a metal surface

plate main body 19 whose plane shape is a rectangular shape, while a peripheral edge is left. A lower opening of the recessed part 21 is closed with a thin plate 22, and an edge of the thin plate 22 is adhered and fixed to the peripheral edge 20. Also, suction holes 23 are formed in a surface of the thin plate 22 at regular intervals in right, left, upward and downward directions. Each suction hole is connected to an evacuating means through a manifold 24 installed at the surface plate main body. A though hole 25 connected to the inside of the recessed part 21 is formed at a side surface of the peripheral edge 20 of the surface plate main body 19 and connected to an air supply means, so as to send the air to the closed recessed part 21 and accordingly expand the thin plate 22 outwardly.

The thin plate 22 closing the recessed part 21 has a thickness of 30μ~200μ, and preferably, a stainless thin plate having a thickness of 100μ is used as the thin plate 22 and molded in almost the same shape as the metal surface plate main body 19, and an edge of the thin plate 22 is fixed to the surface of the peripheral edge 20 of the surface plate main body 19 by an adhesive. Each of the suction holes 23 of the thin plate 22 is formed such that a pipe joint flange 26 is fixed to a hole formed at the thin plate 22 and a miniature tube joint 27 is connected and fixed to the tube joint flange 26. The miniature tube joint 27 of each suction hole 23 is connected through a proof-pressure hose to a communication port 29 of the manifold 24 drilled in a thickness of the metal surface plate main body 19 and communicating with a vacuum communication hole 28. By such a structure, a vacuum absorption force is generated at the suction hole 23. The shown manifold 24 includes four communication ports 29 so that one manifold 24 corresponds to four

suction holes 23, but the number of communication ports is not limited by what is shown in the drawing and 3 or 5 ports may be formed. The point is that the number of communication ports is determined by the number of suction holes installed at the thin plate 22. Needless to say, the disposition of the suction holes 2 is made so that an absorption (suction) force is evenly applied on the surface of the thin plate 22.

Also, a transparent part 30 for performing mark alignment of upper and lower glass substrates a and b is installed at each corner of the upper surface plate 5. As for the transparent part 30, in order to follow an up and down bending movement of the thin plate 22 formed at a lower surface of the metal surface plate 19, a bellows connection member 32 is coupled and assembled to a bellows supporter 31 screw-fixed to a side of the metal surface plate main body 19, a hole having a predetermined diameter is formed at the thin plate 22, a bellows connection member 33 is adhered and fixed to an inner side of the thin plate 22, coinciding with the center of the hole, and a bellows 34 is installed between the bellows connection member 33 and the bellows connection member 32. Also, total four transparent parts 30 are formed. Here, every two parts 30 located on the diagonal line form a pair, and one pair is used for rough mark alignment and another pair is used for fine mark alignment.

Attachment of glass substrates made by the attachment device A having the aforedescribed surface plates will now be described. A lower glass substrate a is put on the lower surface plate, and an upper glass substrate b is placed under the upper surface plate 5 as a suction force generated at the suction holes formed at the thin plate 22 sucks (absorbs)

the substrate b and maintains the sucked state. Then, the movable plate 3 to which the upper surface plate 5 is mounted is moved downwardly by the operation of the air cylinder 13, thereby contacting the upper glass substrate b to a surface of the lower glass substrate a on the lower surface plate 4. In such a state, the upper surface plate 5 is moved in the direction of X and the lower surface plate 4 is moved in the directions of Y and θ by data detected by a mark detecting means including a microscope and a camera, performing rough alignment and precise alignment of the upper and lower glass substrates. The mark alignment is made through the transparent parts 30 installed at the corners of the upper surface plate 5.

When the mark alignment is completed in the aforementioned manner, the movable plate 3 is further moved downwardly, to press the upper and lower substrates. By such pressing, a sealing material c is pressed and accordingly both the substrates are attached(bonded). Here, because the upper surface plate 5 has a buffer structure where the lower opening of the recessed part is closed by a thin plate 22 and the recessed part is sealed hermetically with the air filled therein, the upper glass substrate b is in a state like being pressed by an airbag. Accordingly, although the upper and lower glass substrates have uneven thickness (e.g., tapering), such unevenness may be attenuated by the buffer structure of the upper surface plate 5, such that the uniform distribution weight is applied on the upper glass substrate b and the sealing material is pressed uniformly. Consequently, a constant gap between the upper and lower glass substrates is maintained, the attachment with high precision is achieved.

[Effect of the Invention]

In such a surface plate structure used in the attachment device of glass substrates for a liquid crystal display panel in accordance with the present invention, upper and lower glass substrates are pressed by a buffer structure, so that unevenness (tapering) of thickness of the glass substrates can be absorbed(attenuated) and accordingly a sealing material can be uniformly pressed. Accordingly, the surface plate of the attachment device can implement the attachment with high precision, making a constant gap between the upper and lower substrates.

Also, if a transparent part is installed at each corner of a surface plate as claimed in claim 2, mark alignment for upper and lower glass substrates can be performed by the surface plate, and after completion of the mark alignment, the surface plate presses the glass substrates to thereby perform attachment(bonding) with uniform weight distribution. Accordingly, the surface plate can consecutively implement the mark alignment, the attenuation of the unevenness(unevenness) of plate thickness, and the attachment.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Figure 1 is a sectional view which illustrates an attachment device having a surface plate in accordance with one embodiment of the present invention;

Figure 2 is a partially cut-out plan view which illustrates a surface plate installed in the attachment device;

Figure 3 is a vertical sectional view taken along line (3)-(3) of Figure 2;

Figure 4 is a vertical sectional view taken along line (4)-(4) of Figure 2; and

Figure 5 is a view for explaining the attachment operation on glass substrate by the surface plate.